The status of NASA's Wide-field Meteor Camera Network and preliminary results

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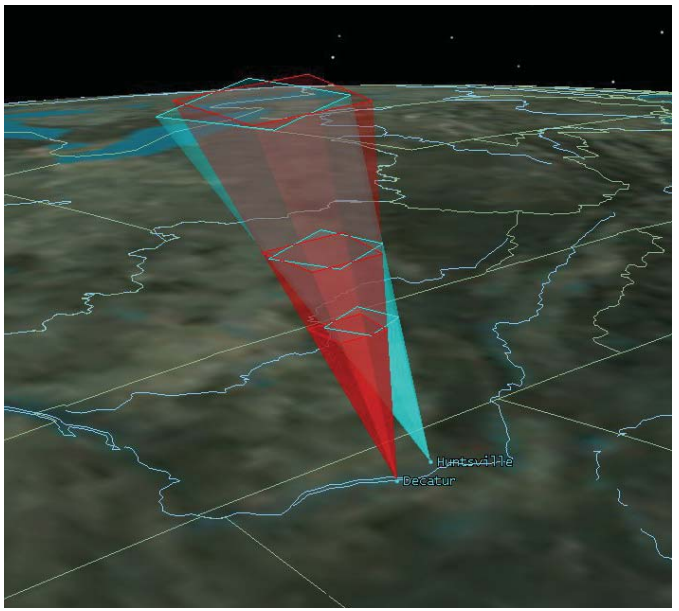
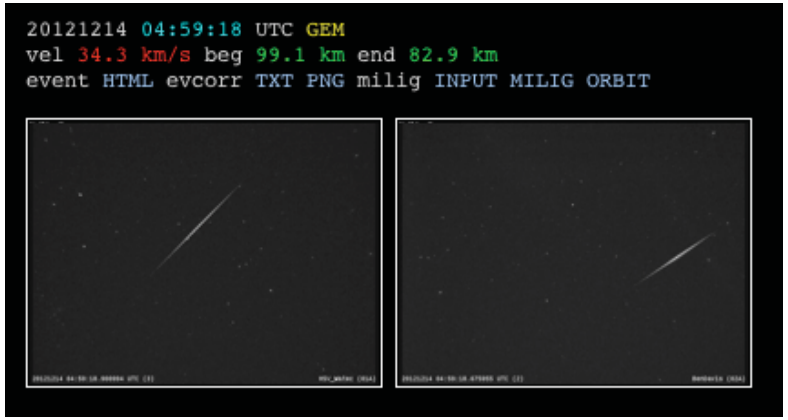
Hardware

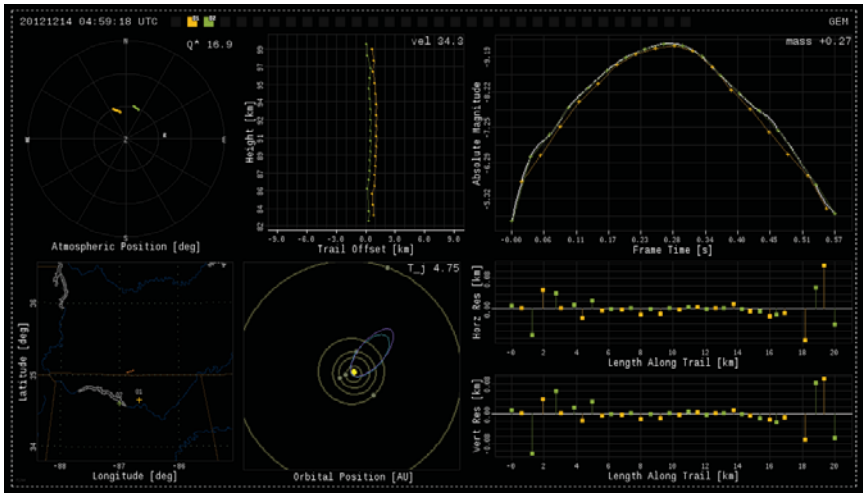
- Two wide-field cameras (21° x 14° field of view)
  - 17 mm Schneider lens on a Watec CCD camera
  - Located 19.7 miles apart – one at MSFC, other at elementary school in Decatur, Alabama
  - Pointed to optimize the common area of the atmosphere between 80 and 120 km height
  - Camera 1 at MSFC est. summer 2011
  - Camera 2 in Decatur est. December 2012



Software

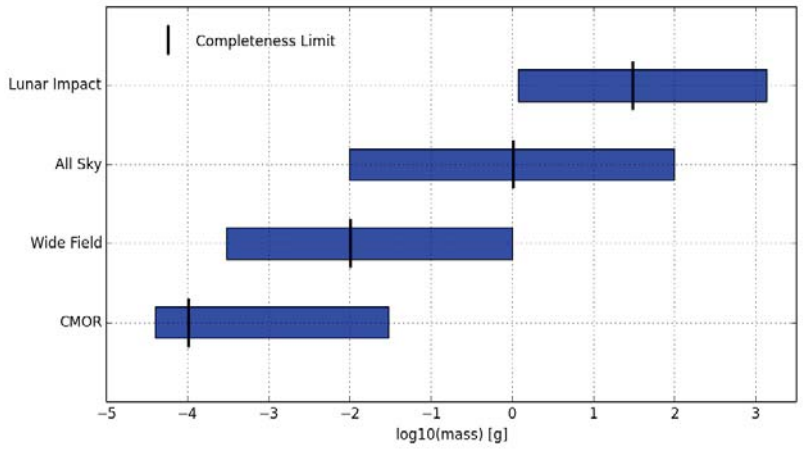
- All Sky Guided Automatic Real-time Detection (*detection* software)
  - University of Western Ontario – Rob Weryk
  - ~3/4 meteors automated detection+ ~ 1/4 pulled from rejects/buffer
- Up to 70 single station, 30 two station events, on a clear non-shower night
- Invokes MILIG & MORB to determine trajectory, speed &orbit

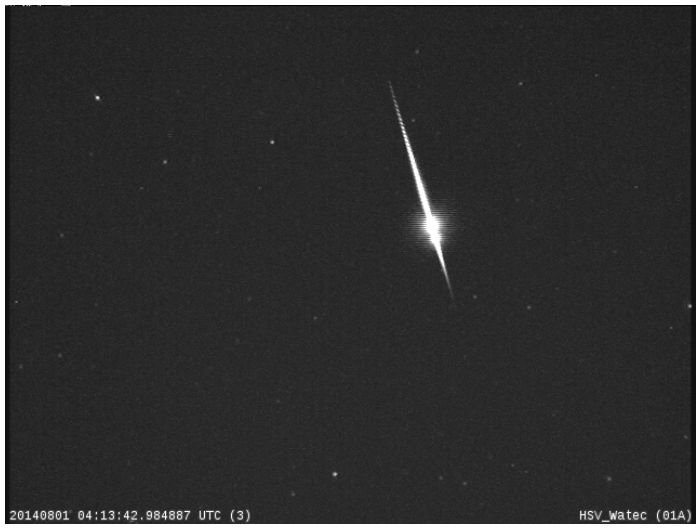




Purpose

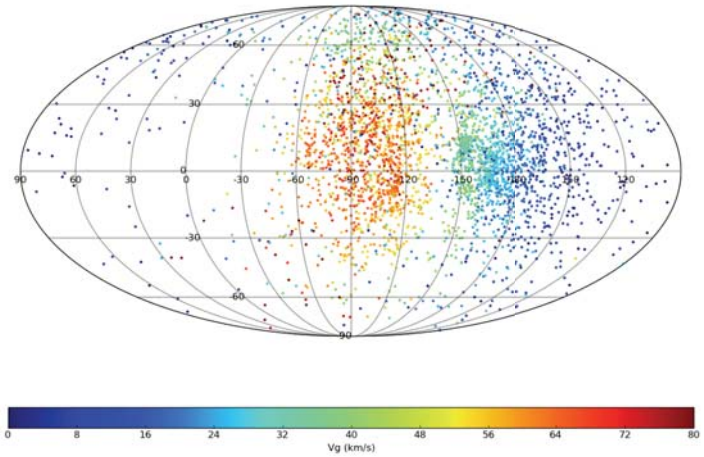
- Fluxes
- Calibrate NASA's engineering meteoroid models
- Understand meteoroid environment in mm-size range
- Densities
- Continuous observations for the Meteoroid Environment Office from 0.0001g to 1000g



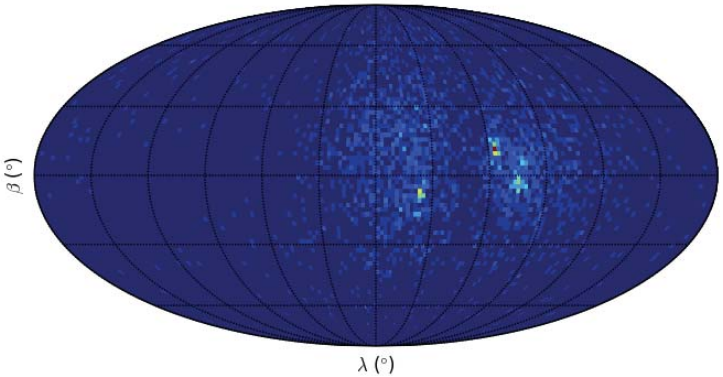


Results

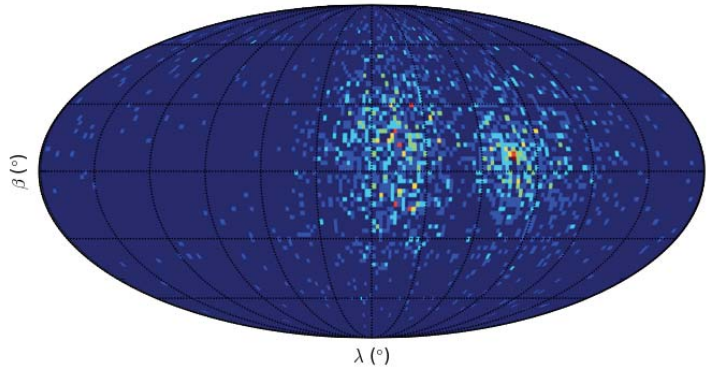
3,440 orbits, Dec 2012-May 2014



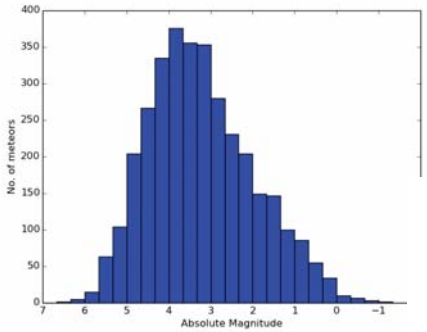
Radiant map of all 3,440 meteors

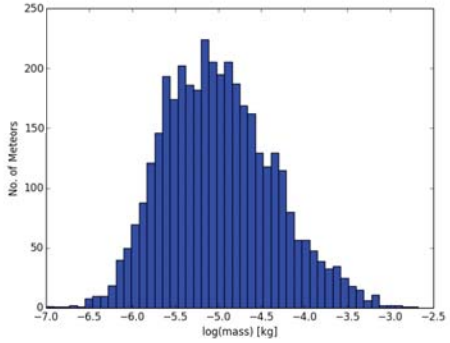


Density plot of all 3,440 meteor radiants



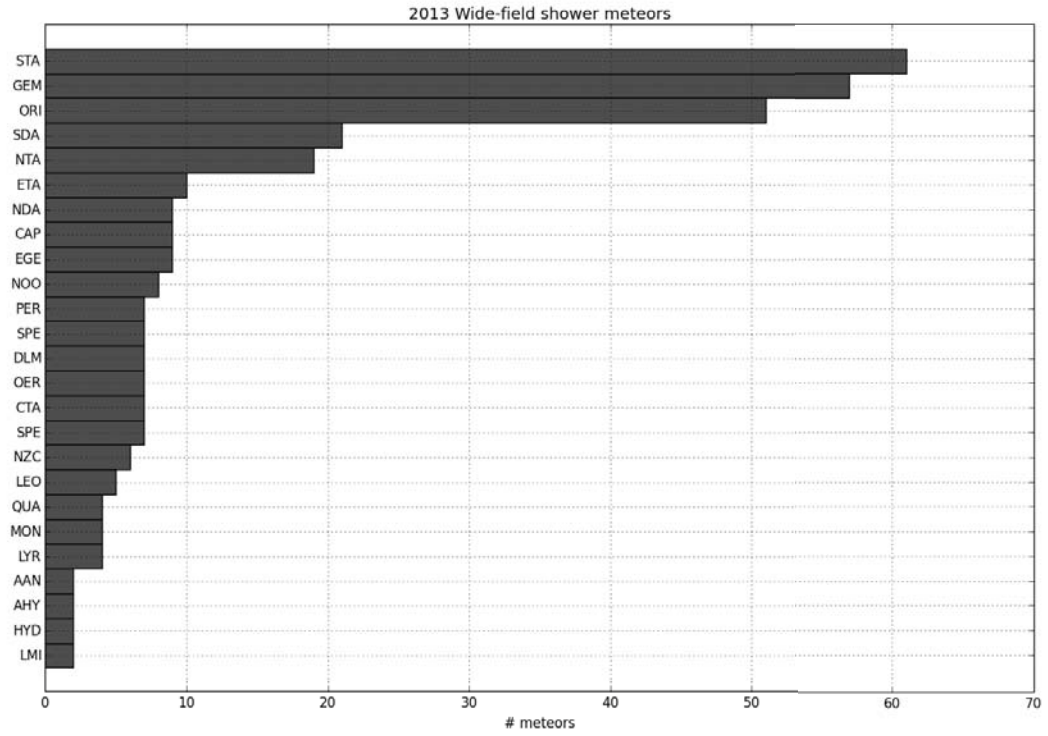
Density plot of all 3,050 sporadic meteors radiants





Results (3,440 orbits, Dec 2012-May 2014)

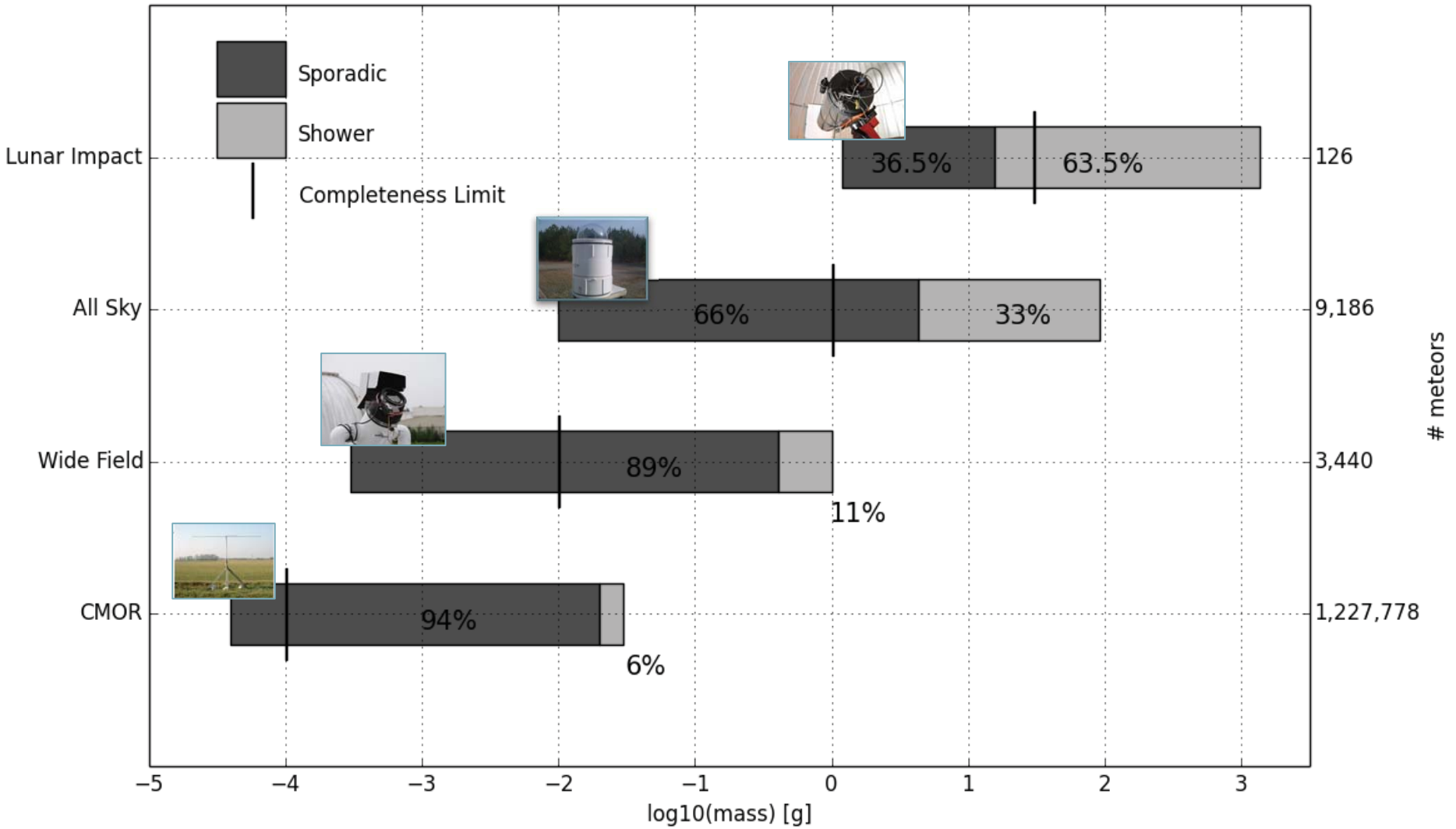
- 3,440 orbits
  - 3,050 identified as sporadic (88.7% sporadic)



Shower Identification

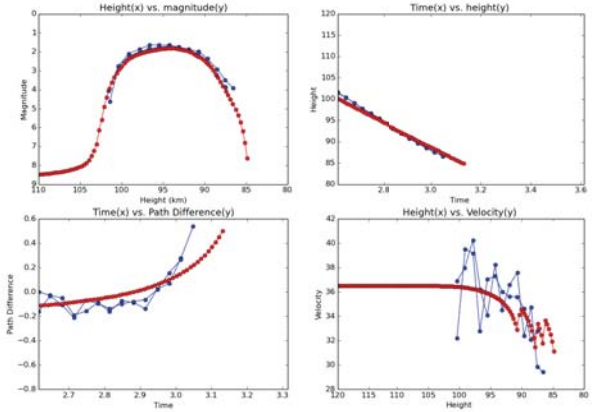
- Double-Station
  - Radiant within 7.5 degrees of shower radiant and velocity within 20% of shower velocity
- Single-Station
  - Great circle constructed with starting and ending points
    - If great circle comes within 7.5 degrees of radiant and …
  - Estimate height at start of event using angular velocity and known shower speed
    - Test height against min and max height values found with fits of min and max heights based on shower speed

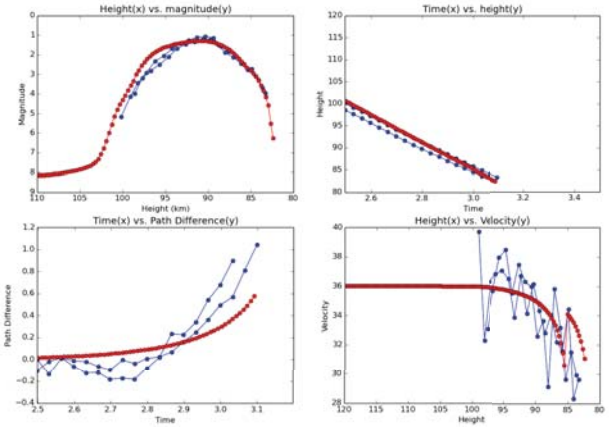
Shwr vs sporadic – 4 systems



Results: Densities

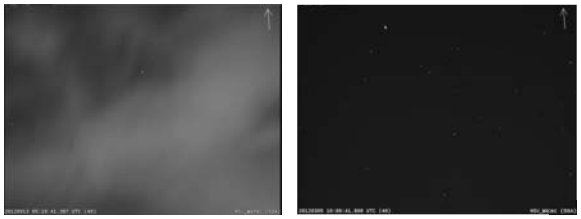
- Model of meteoroid ablation by Dr Margaret Campbell-Brown
  - Thermal disruption to model release of grains during ablation
- Light curves + Deceleration used
- 10 Geminids seen in 2012 showed clear deceleration.
  - 2.6 to 3.3 g/cm^3





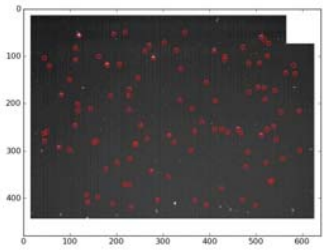
Fluxes:

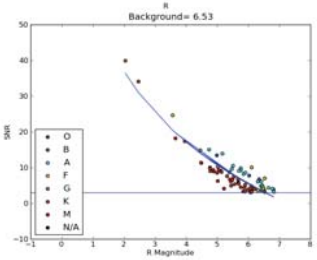
Weather

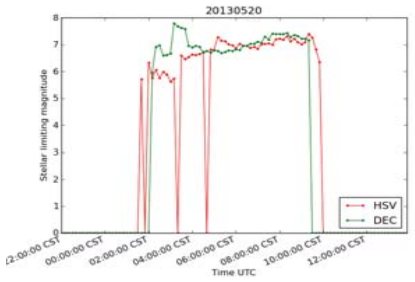


- Uses avg. background and standard deviation
- every 10 minutes

Limiting Stellar Magnitude







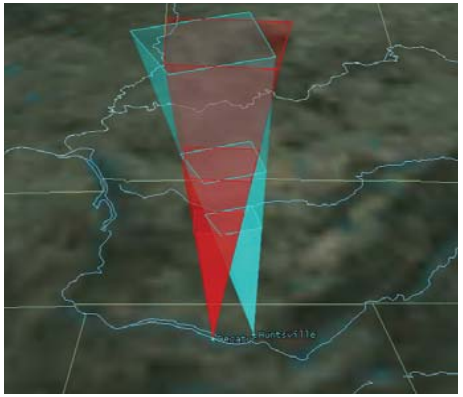
- Identifies stars (astrometry.net and WCSTools) in the calibration images
- Finds their signal-to-noise ratio (aperture photometry)
- Finds R-magnitude which the logarithmic fit intercepts background

Limiting Meteor Magnitude

$$M_M = M_S - 2.5\log(d)$$

$$d = \frac{180 r_1 V \tau \sin(\zeta)}{\pi F_{OV} R}$$

Collecting Area



1) Find true area of the sky that can be seen at each height.
2) Apply corrections to find the effective collecting area per meteor shower or sporadic source.
   - Range
   - Camera Sensitivity
   - Radiant location
   - Angular Velocity

Fluxes

- AUTOMATED
- Per sporadic source and active shower
- Every hour + total night average
- scaled to same limiting mass as CMOR, 1.1e-07 kg
  - And magnitude +6.5, for easy ZHR calculation

20131211 had dew problems on HSV camera all night
20131212 had dew problems on DEC camera halfway thru night

2012 Geminids	CMOR	Huntsville SS	Decatur SS	# meteors used	Double-Station	# meteors used
20121214	0.0549	0.0372	0.0483	44 & 39	0.0383	18

2013 Geminids	CMOR	Huntsville SS	Decatur SS	# meteors used	Double-Station	# meteors used
20131211	0.0653	0.0586	0.0561	3 & 19	0.0629	2
20131212	0.0802	0.1279	0.1226	43&26	0.2112	14
20131213	0.0927	0.1038	0.0956	37&37	0.2686	29

SS fluxes have large errors due to the shower identification being an approximation

Future:

- Three more two-station wide-field systems (quadruple our #'s)
  - By Leonids 2014
- 2564 meteors in 2013 (2230 were sporadic)
  - Projected 10,000 meteors in 2014
- Trying out different lenses (navitar vs schneider)
  - Testing system in Alabama, hoping to move to Arizona or New Mexico, OR put an additional system out there, depending on how much upkeep
  - 32% of alabama nights cloudy
- OMG Cameras